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AAS UNDERWATER ELAPSED TIME CAMERA SILHOUETTE PHOTOGRAPHY EXPERIMENTS AT LOCH NESS, 1989

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INTRODUCTION

The possible existence of large, unidentified aquatic animals in Scotland's Loch Ness still intrigues investigators, including members of the Academy of Applied Science (AAS), which is resuming studies which were intensively carried out in the 1970's, and earlier summarized in this journal (Robert H. Rines, 1982, Summarizing a Decade of Underwater Studies at Loch Ness, *Cryptozoology,* Vol. 1: 24–32).

This report, preliminarily drafted by Harold "Doc" Edgerton before his sudden death in early January, 1990, describes the final research activity and Loch Ness fieldwork of Doc's long and illustrious career. The fieldwork was centered on improving upon earlier underwater elapsed time camera equipment of his design; this was specially adapted for making use of the sun's rays and the long, summer daylight hours of northern Scotland as the source of back illumination for silhouette imaging of underwater objects passing over an upwardly-looking camera.

Earlier designs and tests of this nature were previously reported in this journal (Robert H. Rines, Harold E. Edgerton, and Robert Needleman, 1984, Activities of the Academy of Applied Science Related to Investigations at Loch Ness, 1984, *Cryptozoology,* Vol. 3: 71–73). These, in turn, were sparked by some interesting earlier silhouette shapes, photographed by an Edgerton 16mm camera of 1975 vintage, that continued elapsed-time frame exposures after the strobe batteries had been exhausted (Robert H. Rines, Charles W. Wyckoff, Harold E. Edgerton, and Martin Klein, 1976, Search for the Loch Ness Monster, Figs. D and F, *Technology Review,* Vol. 78[5]: 25–40).

The continued objective was to deploy the camera floating underwater above an anchor, with no ropes or cables to the surface, thus leaving the open space over the upwardly directed camera lens unobstructed.

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FIG. 1.—The Edgerton camera cylinder on ground, attached to the two bouyant suspension spheres. Justice Rines (left) and Harold "Doc" Edgerton are seen relaxing on Temple Pier, Urquhart Bay, Loch Ness, on July 6, 1989.

NARRATIVE DESCRIPTION

The camera, unlike the earlier above-mentioned versions, consisted of a pair of in-line 35mm film spools separated by a sprocket drive powered from a 6-volt battery—parts put together by Bill MacRoberts, of the Strobe Laboratory of the Massachusetts Institute of Technology (MIT), from earlier National Geographic Society projects. The camera operated in a continuous mode at a very slow rate (about 10 seconds between frames), with the sprocket driving a switch that discharged a capacitor into a lens shutter-operating magnet, producing a $\frac{1}{25}$ second exposure time for each frame. The film spools were No. 10 daylight loading spools of 125 feet of thin Estar base Type 2475 film, providing for 2,000 separate pictures, each measuring 1″ × ¾″. The board carrying the spools and the fixed focus f/4.5, 35° lens was inserted within a steel cylindrical housing with a watertight sealed glass window adjacent to the lens.

The camera was deployed in Urquhart Bay, Loch Ness, in July, 1989. Participating in these preliminary experiments was Adrian Shine, a resident

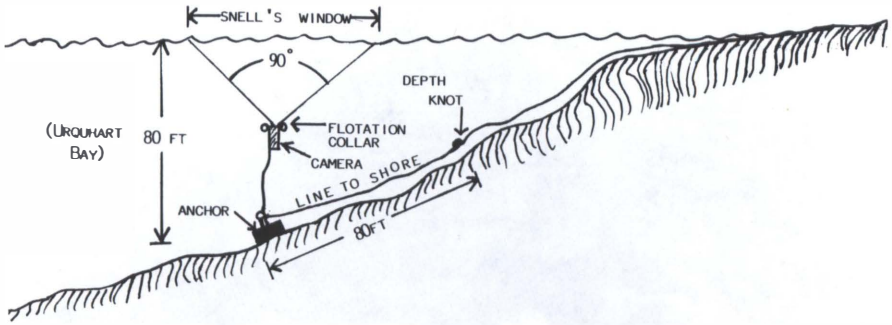

FIG. 2.—The deployment technique of the underwater floating silhouette camera in Urquhart Bay, Loch Ness.

researcher who had conducted the earlier Operation Deepscan sonar survey of the loch, in 1987, among other studies. Shine's ingenuity and assistance resulted in a simple and effective floating suspension system comprising a collar formed by a pair of bouyant spheres lashed to the camera cylinder at its lens end (Fig. 1).

A description of the deployment technique is in order. It involved securing the camera to an anchor with a line, which positioned the camera window 40 feet below the water surface (Fig. 2). A line to shore was also secured to

FIG. 3.—Shore line being carried by boat. Charles Wyckoff (left) and Adrian Shine in boat.

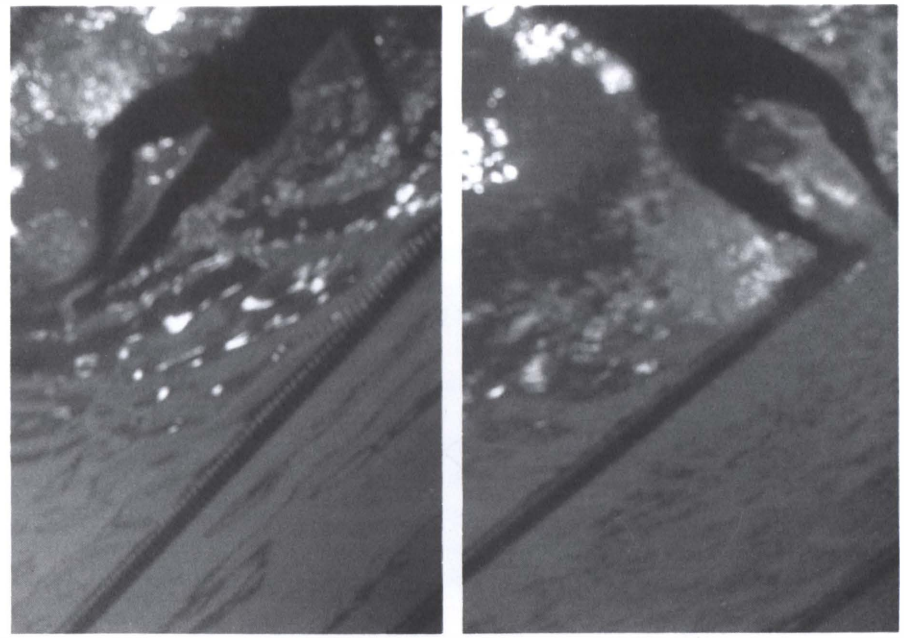

FIG. 4.—Sun-lit photographs obtained in swimming pool tests at the Massachusetts Institute of Technology.

the anchor; it had an identification knot spaced 80 feet from the anchor, with the line allowed to follow the bottom contour as it led to shore and its attachment on the beach. When deploying the camera, this shore line was carried by boat to the approximate location (Fig. 3), and then, while the identification knot was held by hand at water surface level, the boat was moved outward or shoreward until the anchor hit bottom.

Since the identification knot was 80 feet from the anchor, the depth of the anchor on the bottom was accurately determined, and thus the camera lens was known to be 40 feet below the surface. A reverse operation was used in retrieving the camera. Several exposures were made in this mode. Additional exposures were made at different surface-to-camera depths in order to verify the developed film density predictions.

RESULTS

The initial focusing and calibration tests at the MIT Strobe Lab and swimming pool were recently humorously described by Trude E. Bell (1989, 'Doc' Edgerton: An Electrical Engineer for All Seasons, *IEEE Spectrum,* Vol. 26[9]: 52–57). These tests resulted in encouraging sun-lit photographs (Fig. 4).

However, swimming pool water and the waters of Loch Ness are quite dissimilar. Our studies at the loch, while not detecting anomalous swimming

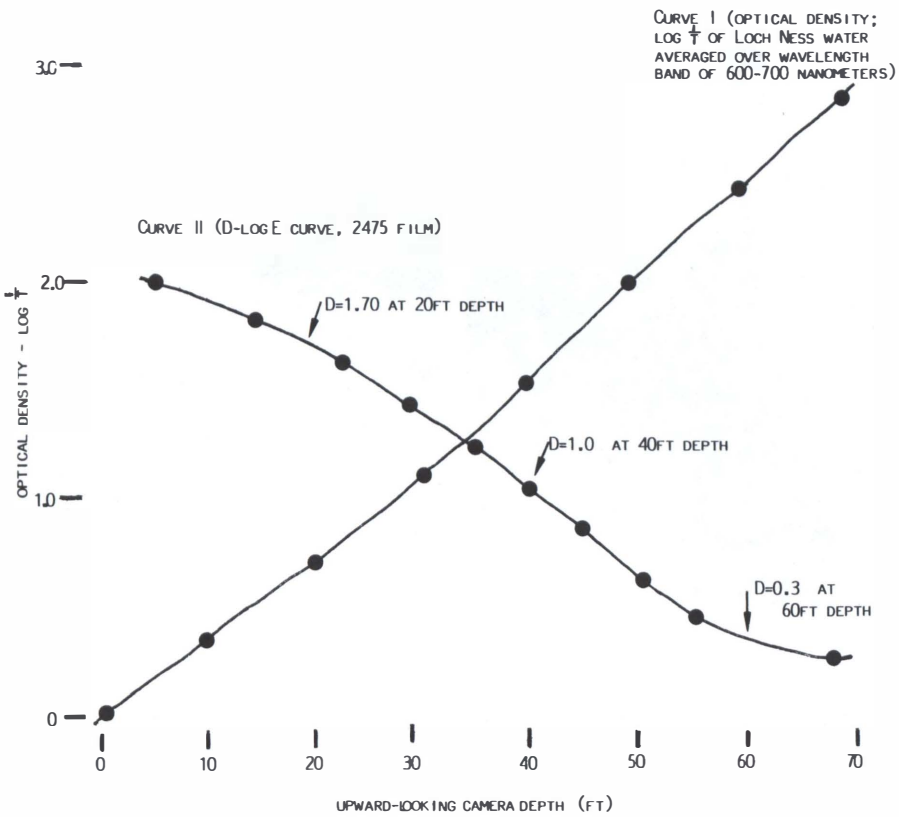

FIG. 5.—Underwater silhouette camera exposure conditions at Loch Ness: optical density as a function of upward-looking camera depth. Kodak recording film 2475; extended red sensitivity; $^1/_{25}$ sec., f/4.5; overhead sun-colored by Loch Ness water.

objects—which would have been an unexpected bonus for this equipment testing program—did result in a better knowledge of the underwater film exposure conditions at Loch Ness. This now enables the publication of a calibration curve (Fig. 5), plotting optical density as a function of upward-looking camera depth. Curve I provides a ready reference for the amount of light absorption in Loch Ness for water path lengths from 0 to 70 feet. For example, over a water path of 70 feet, only a tenth of a percent of the light will be transmitted. The other 99.9% is absorbed or not available for practical use.

Curve II is basically a D-log E characteristic curve of the film Type 2475 when exposed to direct overhead sunlight in the silhouette camera at varying depths. The data were adjusted to produce a developed density = 1.0 at a camera depth of 40 feet. According to Curve II, when the camera was at a depth of 60 feet, the developed film density was 0.3, and produced useful

exposures. When the camera was only at 20 feet, the developed film density had a value of 1.7, but again produced useful exposures.

Curve II, moreover, is also useful in a somewhat different way: to predict the length of daylight time during which useful exposures can be made. Let us assume, as an example, that the camera is at a depth of 20 feet, with the sun directly overhead. This would produce a developed film density of 1.7. As the sun deviates from being directly overhead, during either early morning or late afternoon, resulting in a fall-off in light by approximately 30 times, the camera still produces useful silhouettes with a developed film density on the order of 0.3. A greater drop in light value, however, does not record a satisfactory silhouette image.

Four separate rolls of film were used in the camera during the fieldwork. Only two of these ran for the entire 125 foot length. During the exposure tests, a 10-foot-long rowboat was allowed to enter the field of view of the camera for several exposures. During this time, a temporary target was suspended at different depths in order to determine the clarity of objects coming between the camera and the water surface. During most of the several hours of recording time, however, there was nothing in the field of view except Snell's Window (see Fig. 2).

While a 6-volt camera battery should last for several days of operation, one battery was exhausted after the exposure of only 2,000 frames. It was discovered that the camera shutter synchronizer was causing a momentary short circuit across the battery every time the shutter operated, which quickly drained the battery. This was remedied on the last day of operations. This mishap represents a typical example of the many problems encountered during debugging procedures in field tests.

FUTURE PLANS

The 35° angle of the lens proved far too small to take advantage of the 90° provided by Snell's Window (see Fig. 2), and a wider-angle lens will be substituted in the future.

During the last day, we attempted to obtain exposure data at various depths, but, because of high wind conditions, it was very difficult to stabilize the camera to make certain that it was aimed up at the center of Snell's Window. We suspect it was not, because the silhouette of the boat never appeared in any of the exposures. Thus, the validity of the resulting exposure tests for that run remains in doubt, and must be repeated.

It is hoped that this silhouette camera will be used as one of several future imaging tools, should the more comprehensive continual sonar survey of the loch, now planned by AAS, provide interesting targets for identification.

The only sad note is that Harold "Doc" Edgerton will not be with us in person—though his spirit will inspire us to try to find the ultimate answer to the zoological mystery in Loch Ness.